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ABSTRACT

The Internet has considerably empowered libraries and changed common perception of what they entail. Public libraries, in particular, are using technological advancements to expand their range of services and enhance their civic roles. Providing community information (CI) in innovative, digital forms via community networks is one way in which public libraries are facilitating everyday information needs. These networks have been lauded for their potential to strengthen physical communities through increasing information flow about local services and events, and through facilitating civic interaction. However, little is known about how the public uses such digital services and what barriers they encounter. This paper presents findings about how digital CI systems benefit physical communities based on extensive case studies in three states. At each site, rich data were collected using online surveys, field observation, in-depth interviews and focus groups with Internet users, human service providers and library staff. Both the online survey and the follow-up interviews with respondents were based on sense-making theory. This paper discusses findings regarding: (1) how the public is using digital CI systems for daily problem solving; and (2) the types of barriers they encounter. Suggestions for improving digital CI systems are provided. (Contains 50 references.) (Author)

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Public Use of Digital Community Information Systems: Findings from a Recent Study with Implications for System Design

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ABSTRACT

The Internet has considerably empowered libraries and changed common perception of what they entail. Public libraries, in particular, are using technological advancements to expand their range of services and enhance their civic roles. Providing community information (CI) in innovative, digital forms via community networks is one way in which public libraries are facilitating everyday information needs. These networks have been lauded for their potential to strengthen physical communities through increasing information flow about local services and events, and through facilitating civic interaction. However, little is known about how the public uses such digital services and what barriers they encounter. This paper presents findings about how digital CI systems benefit physical communities based on extensive case studies in three states. At each site, rich data were collected using online surveys, field observation, in-depth interviews and focus groups with Internet users, human service providers and library staff. Both the online survey and the follow-up interviews with respondents were based on sense-making theory. In our paper we discuss our findings regarding: (1) how the public is using digital CI systems for daily problem solving, and (2) the types of barriers they encounter. Suggestions for improving digital CI systems are provided.

Categories and Subject Descriptors: DL impact, user studies, case studies, evaluation methods, communities of use/practice, social informatics

General Terms: measurement, performance, human factors, theory

Keywords: community information, community networks, information behavior, barriers, sense-making, qualitative methods

1. BACKGROUND

Every day, citizens require equitable and easy access to local resources that can help them deal with the myriad of situations that arise through daily living. Yet, all people--despite their occupation, education, financial status, or social ties--encounter situations where they experience great difficulties in recognizing, expressing and meeting their needs for such community information (Chatman, 1996, in press; Chen and Hernon, 1982; Dervin, et al., 1976; Durrance, 1984a; Harris and Dewdney, 1994; Pettigrew, 2000; Pettigrew et al., 1999). Financial, physical, geographic and cultural barriers also prohibit individuals from successfully seeking information. As a result, many people cannot obtain important information, access needed services, or participate fully in their community's daily life. While information technologies hold significant promise for linking individuals with information and one another, they are foreshadowed by the potential for a deeper digital divide between the information rich and the information poor.

Public libraries have long recognized the importance of community information (CI) for creating and sustaining healthy communities. Comprising three elements: survival or human services information, local information and citizen action information (Durrance, 1984b), CI can be broadly defined as:

> any information that helps citizens with their day-to-day problems and enables them to participate [in their] community. It is all information pertaining to the availability of human services, such as healthcare, financial assistance, housing, transportation, education, and childcare services; as well as information on recreation programs, clubs, community events, and information about all levels of government (Pettigrew, 1996, p. 351).

Since the 1970s public libraries have facilitated citizens' access to CI by providing information and referral (I&R) services, and through organizing and supporting community-wide information initiatives with local service providers (Baker and Ruey, 1988; Childers, 1984). The Internet, along with high-speed personal computers, modems, and graphical interfaces, has suggested new ways for libraries to facilitate citizens' information needs through digital CI systems. One such digital collaboration in which libraries have taken a leading role and is flourishing throughout the world is community networking.

Since the late 1980s libraries have played pivotal roles in developing community networks (community-wide electronic consortia) that provide citizens with equitable access to the Internet for obtaining CI and communicating with others (Cisler, 1996; Durrance, 1993, 1994; Durrance and Pettigrew, 2000; Durrance and Schneider 1996, Gurstein 2000). Often organized and designed by librarians, these digital networks provide citizens with one-stop shopping using community-oriented discussions, question-and-

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answer forums, access to governmental, social services, and local information, email, and Internet access (Schuler, 1994; 1996). While individuals may interact with other users by posting queries, monitoring discussions, etc., CI is often a central network feature that appears in many forms: libraries, for example, may mount their databases on the Internet, while individual service providers may post information about their programs and services. Thus, the architecture of the Internet makes digital CI possible by linking information files created not only by single organizations such as libraries, but by agencies, organizations, and individuals throughout the community (and, of course, the world). This is a major departure from traditional I&R services where librarians and other CI agency staff work with files about the community that are created on an internal library system. As a result of digital CI systems via community networks people can access CI through public library terminals while seeking help with related search problems from librarians. In short, digital systems mean that citizens can access CI anytime in any place

Despite the lauding of community networks' potential for strengthening physical communities through increased digital CI flow and civic interaction, findings from recent studies (e.g., Kraut et. al., 1999; Nie and Erbring, 2000) suggest that Internet use has the reverse effect by isolating individuals and decreasing interpersonal interaction, which gain greater importance given Putnam's (1995, 2000) observation regarding the decline of social capital in physical communities. Thus, life in an electronic world poses several fundamental problems for research. Two such questions that are only beginning to be addressed include:

(1) How do individuals use digital CI systems when seeking help for daily situations? and

(2) How do public library-community network initiatives strengthen communities?

To date, little is known about how access to digital CI systems help (or do not help) citizens with daily living, how CI affects their information behavior, and how it may or may not benefit communities. In a recent literature review (Pettigrew, Durrance, and Vakkari, 1999), we observed that research interest in citizens' use of networked CI is increasing. However, the majority of papers were applied and descriptive in nature and were based on questionnaires or analyzed transaction log data that revealed user socio-demographics and system or page use frequency (e.g., Geffert, 1993; Harsh, 1995; Harvey and Horne, 1995; Patrick, 1996, 1997; Patrick and Black, 1996a&b; Patrick et al., 1995; Schalken and Tops, 1994), which confirms Savolainen (1998). Most studies were from the professional literature and reported conflicting user and use statistics, especially regarding user socio-demographics. In this sense, the digital CI system literature has been akin to the general public library literature that Zweizig and Dervin (1977) criticized as providing little insight into the uses that people make of information and information systems. One study of particular note, however, is Bishop, et al., (1999). Through interviews and focus groups in low income neighborhoods with users and potential users of the Prairienet community network, they identified the following categories of digital CI need: community services and activities, resources for children, healthcare, education, employment, crime and safety, and general reference tools. They recommended that libraries might provide more effective digital information services if they focus on ways that complement citizens' lifestyles, constraints and information seeking patterns.

2. CURRENT STUDY

Our research questions addressed the situations that prompt citizens to use/not use digital CI systems for everyday help, the specific types of CI that they are seeking, how they deal with different barriers that they encounter, and how they are helped by the CI that they obtain. Our study also focused on how public libraries and community service providers perceive digital CI systems help their clients, their own organizations, and the community at-large. We were particularly interested in how the public's perceptions of digital CI systems related to those of service providers and librarians.

Since our study was exploratory and aimed at yielding rich data, we used multiple methods over several stages. Stage 1 comprised a national survey with 500 medium and large-sized public libraries regarding their involvement with digital CI systems. For Stage Two, we used a standard design to conduct intensive case studies in three communities (Table 1) that received national recognition for their respective community network and in which the local public library system played a leading role.

Data collection methods at each site included (a) an online survey and follow-up telephone interviews with adult community network users who access "tagged" CI web pages, along with (b) in-depth interviews, field observation and focus groups with public library-community network staff, local human service providers, and members of the public. The survey was posted (during different time periods) on the main CI page of each network. The steps we took to address methodological considerations when conducting online surveys (as discussed by Witte et al., (2000) and Zhang (2000)) are discussed in an earlier paper (Pettigrew and Durrance, 2000). The number of days each survey ran and the total number of responses for each network are summarized in Table 2.

Table 1. Overview of Data Collection Sites

Site	Counties/ Areas Served	Public Library System	Community Network	
			Name (URL)	Est.
Northeastern Illinois	Cook, DuPage, Kane, Lake, McHenry & Will	Suburban Library System	NorthStarNet (nsn.nslsilus.org)	1995
Pittsburgh, Pennsylvania	Southwestern Pennsylvania	Carnegie Library of Pittsburgh	Three Rivers Free-Net (trfn.pgh.pa)	1995
Portland, Oregon	Multnomah County	Multnomah County Library	CascadeLink (www.cascadelink.org)	1996

Table 2. Overview of Online Survey Responses

Community Network / Area Served	# Days Survey Posted	# Responses	Gender			Age Range						
			M	F	NA	18-25	25-35	36-45	46-55	56-65	66+	NA
NorthStarNet Northeastern Illinois	60 days	34	10	20	4	6	9	9	5	2	1	2
Three Rivers Free-Net Pittsburgh, Pennsylvania	90 days	123	57	61	5	10	30	22	30	15	9	7
CascadeLink Multnomah County, Portland	70 days	40	17	20	3	5	7	9	11	3	2	3
Total:	220 days	197	84	101	12	21	46	40	46	20	12	12

Both the user survey and follow-up interviews were based on Dervin's sense-making theory (c.f., Dervin, 1992; Savolainen, 1993), which comprises a set of user-centered assumptions and methods for studying the uses individuals make of information systems. It asserts that throughout daily life, people encounter gaps in their knowledge that they can only fill or bridge (in Dervin's terms) by making new sense of their situations through seeking information. Thus they use varied strategies to seek and construct information from different resources or ideas as they cope with different barriers. Sense-making facilitates the study of different aspects of information behavior. Our research included two aspects: (1) users' assessments of the helpfulness of digital CI, and (2) users' and service providers' constructions or images of these systems. Both were investigated using the micro-moment time-line technique where respondents were asked "to reconstruct a situation in terms of what happened (time-line steps) [and then] to describe each step in detail" (p. 70), which enabled us to gather and comparing the perceptions of different players regarding how CI is constructed and used through electronic communication. The framework's social constructionist orientation suggested it would be viable for studying citizens' online information behavior. In addition to the sense-making propositions, we examined our qualitative data for such themes such as indicators of social capital, and analyzed our quantitative data for such patterns as the relationship between users' perceptions of how they were helped by the digital CI and their willingness to access it again for help in similar situations.

In the remainder of this paper, we share our findings regarding: (1) how the public is using digital CI systems (i.e., their information needs), and (2) the barriers they encounter in the process. Suggestions for improving the design of digital CI systems are also discussed. In future publications we are addressing how users are helped by digital CI systems and how these systems contribute to building social capital at the individual and community levels.

3. How the Public is Using Digital CI Systems

The respondents' age groups followed a normal distribution with most respondents (71.4%) falling between the ages of 25 and 55, while slightly more women (54.6%) responded than men. Thus our findings suggest that a typical user is non-existent, socio-demographically speaking: users equally represent both genders, a distributed range of age groups, and a diverse range of occupations: from students to blue-collar workers to white-collar professionals. Moreover, our respondents comprised both first-time or novice users as well as very experienced searchers.

Our respondents reported that they use digital CI systems for many different types of situations, including those of a personal nature and those regarding the workplace. This confirms a tenet of information behavior, namely that all individuals require community information at one point or another and that it is the individual's situation that reveals most insight into information seeking and use (Harris and Dewdney, 1994). We found that users seek the following types of digital CI (in alphabetical order):

- Business
- Computer and Technical Information
- Education
- Employment Opportunities
- Financial Support
- Governmental and Civic
- Health
- Housing
- Library Operations and Services
- Local Events
- Local History and Geneaology
- Local Information (local accommodations, community features)
- Local News (weather, traffic, school closures)
- Organizations and Groups
- Other People (both local and beyond the community)
- Parenting
- Recreation and Hobbies
- Sale, Exchange, or Donation of Goods
- Social Services
- Volunteerism

These categories are markedly different from those traditionally used to classify CI needs. Moreover, they also broaden findings reported by Bishop, et al. (1999). Notable differences between our categories and those reported in CI studies conducted prior to the Internet are: (1) a strong emphasis on employment opportunities, volunteerism, and social service availability; and, (2) the inclusion of such new categories as: sale, exchange and donation of goods, local history and genealogy, local news, computer and technical information, and other people (residing both within and beyond the community).

What is the reason for this emphasis on employment information, etc., and the emergence of novel categories? Our analysis indicates that the Internet is responsible. Increased computer capabilities and online connectivity have enabled many different types of service providers to make information available about themselves that was

previously unavailable or only in limited amounts via a public library's CI record. In other words, service providers are now able to share information about themselves first-hand. Prior to the Internet, such information was largely only available on paper and had to be searched manually and often through intermediaries (although many public libraries maintained electronic, in-house databases, these databases were seldom available to the public for direct end-user searching). The breadth of CI available, along with new search engine and software capabilities, has contributed to extending the notion of what CI comprises. Just as the Internet is broadening our concept of community, so it is changing the scope of community information. Due to digital CI systems, people can search for other people online, sell and trade goods, research their family history, exchange neighborhood information—and all at a faster, more immediate pace. Increased access to the Internet, and hence community network, especially via public libraries has led to an increased public awareness of what's available, what's going on and what might be found in a community. This enhanced access is undoubtedly facilitating CI flow. Whereas people once relied on conversations over backyard fences, postings on notice boards at supermarkets, and local newspapers, they are now drawing upon the capabilities of the Internet, as fueled by public library efforts, to seek and share information about their communities.

While the above categories are useful for understanding the types of digital CI that users seek, further insights are gained when one considers the actual situations. The following are just a few examples:

- Teenagers used the network to find summer employment because it has all the local job information in one place and is trusted it as a reliable, current source;
- A senior used the network to find out about an important upcoming town council meeting;
- A man looking for a local directory of gay and lesbian organizations searched the Web, but only came across national resources. The network directed him to the exact local organization he needed.
- A homebound person used the network to research his family's genealogy because its comprehensive organization of local resources, including public library, county agency and local historical association materials;
- A former resident organized a family reunion from across the country using the network to arrange everything from activities to hotels;
- A woman used the network to learn about local government information, such as current ordinances pertaining to matters ranging from trash pick up to flood damage prevention, and to identify sources of funding for a community service project intended to help a nearby low-income community;
- A man, who sometimes uses the network to find miscellaneous information, said he uses it "mostly for help with lung cancer and possible cures or ways of living longer whether it be conventional or alternative medicine."

According to sense-making theory, information needs cannot be considered in isolation of the situations that create them since any situation is likely to yield multiple information needs, i.e., information found for one aspect of a query frequently opens another, related information need. As we found, the situations for which users sought digital CI were complex and usually required multiple pieces of information. In this sense, our users described how their searches were ongoing and how they anticipated having to pose several different queries or consult multiple sources. This notion of the ongoing search is similar to Bates' (1989) "berrypicking" concept where users search for information "a bit at a time" and alter their search strategies according to what they find and what barriers they encounter.

Beyond analyzing the CI that users sought by need category and situation type, we also focused on the information's enabling aspects, i.e., the attributes of the information that would aid users in whatever it was they were trying to accomplish. This approach builds on Dervin's notion of "verbings." We derived the following "information enabling" categories for classifying the types of CI requested:

- ***Comparing*** (similar to verifying but may come earlier in the cognitive process)
- ***Connecting*** (how to find people with related interests, etc.)
- ***Describing*** (services offered, cost, eligibility, etc)
- ***Directing*** (information about where something is located or how to get somewhere)
- ***Explaining*** (in-depth, content-oriented information that explains how something works)
- ***Problem solving*** (information that will help bridge a gap or solve a problem)
- ***Promoting*** (want others to know about them, e.g., that they're available for employment, that they've started a new club, etc)
- ***Relating*** (information that is relevant to the individual's needs and situational constructs as perceived by the individual).
- ***Trusting*** (information that individuals perceive as coming from a trusted source. This is similar to high-quality CI, i.e., CI that is accurate and current, which people said they wanted)
- ***Verifying*** (a form of corporate intelligence, people want to keep up with what their competition is doing, be aware of new trends, etc.

These "enabling" attributes provide a novel way of viewing information needs because they focus on what users are trying to accomplish for a particular situation. When considered in conjunction with (a) the user's initial need (as presented to the digital CI system by either point and click or by typing a search phrase), (b) the situation that prompted that need, and (c) what is known about the barriers that users encounter—as discussed later—these enabling categories reveal several implications for the design of digital CI systems.

4. Other Findings Regarding the Public's Online Information Behavior

Several other novel themes emerged regarding citizens' online information behavior that contribute to the literature and may aid in digital CI system design. For example, respondents indicated that they often tried other sources (e.g., friends, newspapers, telephone directories, etc.,) for help with their questions before turning to the system. Such was the case of a user from Pittsburgh, who accessed the Three Rivers Free-Net after friends and co-workers told him that it contained job listings and other sources such as local newspapers had proven unsuccessful Since the 1960s, information science research has indicated that social ties and face-to-face communication are primary sources of information, regardless of

the setting (home, workplace, school, etc.). Our findings suggest that this remains the case: the Internet has not replaced the role of social ties in citizens' information behavior. During out interviews, several respondents described how they spoke about their information need or situation with a social tie before searching online. Thus, we found that the Internet is supplementing other information-seeking behaviors in addition to creating new pathways for obtaining information: the public is using digital CI systems as an additional source. Moreover, we learned that people *want* their community networks to promote social interaction by bringing people together. This notion was expressed by a user who said: "a bulletin board or someway to facilitate people meeting each other and getting around would be very helpful. I've recently moved to town and am looking for ways to meet people. Maybe a place where people could find others who are interested in a super club or playing cards, or informal sporting groups, etc."

Users also tended to be highly confident that they could find what they needed through the community network. Despite the difficulties with using the Internet noted in previous studies, such as lack of content, low retrieval rates with search engines, inaccurate information, etc., our respondents tended to perceive their community network as an ubiquitous source and gateway to all knowledge. In this sense we identified a mismatch between what users think they can obtain via the Internet and the likelihood that that information exists and can be easily located. This finding expands on a principle of everyday information behavior: that a mismatch exists between what users believe service providers offer and what they actually do (Harris and Dewdney, 1994). Another plausible explanation is that users are transferring their mental model of what public libraries contain and how they function to the Internet in general. In other words, of community networks and the Internet, users hold the same "information" expectations that they associate with public libraries. The difficulty here, of course, is that public libraries and the Internet are not the same thing: they provide different sorts of information in vastly different ways, with the roles played by professional librarians making a critical difference. An interesting and representative example of users' perceptions of the Internet and community networks came from a young man who asserted that the Internet and community network provided non-biased information—something he associated with public libraries. Later, acknowledging that sometimes information is "sensationalized," he added that he tries to balance information retrieved from the Internet with that gleaned from other sources before making a final decision.

On a different theme, it was interesting how some respondents revealed that they were searching for CI on behalf of another person (e.g., relative, friend), and not always at that person's behest. This notion of proxy searching, of gathering requested and unrequested CI for others, supports recent findings regarding the Web by Erdelez and Rioux (in press), which they describe as information encountering, and by Gross (in press), who describes how users present "imposed queries" at reference desks in public and school libraries. On many levels, it seems that the Internet has made it easier for researchers to label and identify a particular social type, one that might be best described as "information gatherers" or "monitors" to borrow from Baker and Pettigrew (1999). In our study, these active CI seekers, who may be considered somewhat akin to information gatekeepers, appeared to relish time spent browsing and poking about the community network and the Internet. But the greatest satisfaction they described was when they found something that they believed might of interest to someone else, which they would quickly pass on, either by email or in-person. Hence, a distinguishing feature of these CI gatherers is that they are socially connected or active, and, perhaps more importantly, are aware of the potential CI needs or interests of the people with whom they interact. These CI gatherers do not wait for someone to say "I need to know about X."; instead, they take mental notes of what's going on in the lives of the people around them, their interests and situations, and then keep an eye out for CI that might be of interest or helpful—not by initiating an actual, purposive search. In this sense, CI monitors are able to recognize the potential CI needs of the people around them. Another defining element of this social type is that they do not really care if the CI they pass on is actually used, and they exhibit an understanding that sometimes information is used and proven helpful at a later point in time. For systems design, this information gatherer social type has important implications. In communities, for example, that are considered information poor, individuals who represent this social type could be identified and given advance training in Internet searching as well as in how to identify information needs and how to provide information in ways that best facilitate those needs.

We also found support for Wellman's (in press; Hampton and Wellman, 2000) notion that the Internet has created "glocalization" where it is being used by individuals for both local and long-distance interaction. In our study, respondents used the community network as a personal gateway to websites located throughout the world, while people far beyond the network's physical home were using it to obtain local information. A woman in Florida, for example, used the Three Rivers Free-Net to locate information about seniors' housing for her elderly father who was moving to the Pittsburgh area. A different user, who was accessing the network from another region, remarked on how it helps her connect with her family: "although I haven't lived there in years, I can keep up with the events and what is going on." Respondents also expressed interest in having a strong regional and neighborhood emphasis in their networks' content.

5. Barriers to Using Digital CI Systems

The notion of barriers, which is central to the sense-making framework, represents the ways in which people are prevented or blocked from seeking information successfully. By identifying barriers, one can devise ways of improving the design of digital CI systems that facilitate users' information behavior. Our respondents were asked several open-ended questions that address types of barriers. Specifically, we asked them to explain what, if anything, would make it easier for them to find what they're looking for, and to describe any past actions they might have taken regarding their search topic.

Our analysis revealed that users encounter several types of barriers when using community networks and the Internet, in general. We labeled the main barrier as ***"Information-Related."*** Barriers that fell under this broad category included:

- *Low Retrieval Rates: Due to poor search engines and site indexing, users frequently complained that they retrieved too much CI, that search engines did not provide enough specificity (e.g., for retrieving information at the neighborhood level), and that they were challenged with discerning what was relevant to their search. Regarding the Internet, in general, one user said he didn't "like it a lot" because most sites and search engines gave him 10 billion leads that get him sidetracked until he's forgotten what it was he was looking for;*
- ***Information Overload:*** Users were often daunted by a site's layout (e.g., it appeared too busy, too many bells and whistles,

poor font and color choice, especially for those who are color-blind) and the amount of text displayed on a single screen;

- ***Poorly organized (classified):*** Users complained that they often did not find CI where they expected to find it, and that there was little cross-referencing. As one female user explained: "I have a difficult time finding this information. None of the [system] categories apply to this even though I know the entity exists. Search engines didn't help either."
- ***Out-of-date and inaccurate information:*** Users found CI that was either out-of-date or there was no way of discerning when a page was created or last updated. Inaccuracies in content were also noted;
- ***Authority:*** Without proper identifiers and author credentials or association endorsements, users said it was difficult to gauge the "quality" of the CI source, i.e., whether they should trust the CI (and its source) or not;
- ***Missing:*** Users sometimes commented that information was missing although it was described as existing at the beginning of a page or document;
- ***Dead links:*** Users were frustrated when finding a link to a page or site that they believe will be highly relevant to their information need, only to find that the link is inactive or otherwise unavailable;
- ***Language used:*** Beyond most information appearing in English only, users also commented on how some sites contained information that was written using jargon or at a level that was too high for many to understand;
- ***Security:*** Users want strong evidence that the information they submit and retrieve is confidential—"reasurred security"—as one user phrased it;
- ***Specificity:*** Users want to be able to search for information at the neighborhood level. As one user explained, "what's the use of providing information concerning neighborhoods if you then don't make it easy for someone to determine exactly which neighborhood they're in or belong to?"
- ***Non-anticipatory systems:*** Although users were unable to articulate this barrier themselves, their responses in the surveys and interviews indicated that users' information behavior would be greatly facilitated if digital CI systems were "smart enough" either to anticipate their next information need (based on the need posed to the system by typed query or by point and click) or a related information need. All too often users described how the site they found was not quite what they were looking for but they did not know where to go to next.

These information-related barriers point to problems as well as potential solutions for improving the usability and helpfulness of digital CI systems. However, ***other barriers*** that users encounter also emerged from our analysis. Such barriers included:

- ***Technological barriers:*** computer connection speeds were very slow, software worked slowly or unavailable or incompatible with connecting systems, etc.;
- ***Economic barriers:*** users who could not afford their own computing equipment or online access felt they felt were at a disadvantage unless they were able to access equipment at a public library or other public computing site, which even at the best of times, was still not as convenient as having a home system;
- ***Geographic barriers:*** People were hindered in accessing computers because they lived far away from a public library or other public access site, or because high-speed connectivity was unavailable in their area;
- ***Search skill barriers:*** Community network users did not know how to search the system (or Internet in general) or how to use advanced methods. This was reflected by several respondents, one of whom commented "I have a hard time finding information even though I think I'm a pretty savvy web surfer;"
- ***Cognitive barriers:*** Users did not understand how the Internet works in terms of how it is indexed and how search engines work, how links are created, who creates and manages the information, how sites are updated, etc. As one user explained "I am not Internet savvy enough to know what would make it easier—I just muddle through," while another remarked: "there is probably more to the website that I know about;"
- ***Psychological barriers:*** Users frequently expressed a lack of confidence in their own ability to find needed information. In other words, they internalized their search failures: instead of attributing them to the Internet or just a plain lack of availability, they believed the reason they could not find something was because they were unable to carry out the search successfully.

These barriers are highly significant because they represent the impediments that users encounter when seeking information. People who are job seeking, for example, feel that they cannot get ahead unless they have access to a computer, not only so they can become more computer literate, but also because that's how they perceive people learn about job opportunities these days. For any one situation or information need, a user might be confronted by several barriers, which, collectively, can overwhelm the user and prevent him or her from locating needed information.

6. Discussion

Our analysis of users' online information behavior reveals a rich portrait of how individuals are getting faster access to more detailed information in ways that were never possible, even a decade ago due to digital CI system initiatives. These systems are valued and used by all segments of the adult population, and enable individuals, from near and far, to find information about local services and events, and facilitate different types of information seeking. Our analysis of the situations that create users' needs for CI revealed a plethora of rich findings that expand on previous reports, and, more importantly, signify several novel ways in which people are seeking CI at the turn of the century by drawing upon new technologies supported by public libraries. However, our results also indicated that users' mental models of what information exists, is retrievable, and is accurate on the Internet are overly optimistic. Although many barriers are associated with digital CI system access, these same barriers can reveal optimal solutions that will assist in creating even stronger and more information literate communities. Our findings suggest the following ways in which digital CI systems might be improved:

1. Provide users with greater specificity in their searches by improving the capability of search engines and searchable fields. Users, for example, want to be able to search for CI by neighborhood and zipcode, which reflects their notions of community.
2. Incorporate anticipatory search features that offer users suggestions or "next steps" on other types of information that are related to the information currently retrieved. For example, if a user is searching for genealogical information, then the system could suggest other sources of genealogical

information as well as genealogical software for family tree building, etc. This heuristic approach might be developed by querying the user about the context of his/her search, and by linking categories of CI based on users' perceptions of CI and how these categories are used or connected in real-life situations.

3. Query the user automatically regarding the enabling aspect(s) of the information that they are seeking and then use this data to provide information holistically. For example, if a user is seeking "directing" information, then the system might also bring up local bus schedules and routes, directions, etc., through a geographic information system.
4. Use a community information taxonomy, such as Sales (1994), for organizing and indexing CI records and make the taxonomy available online as part of the digital CI system.
5. Follow established interface design principles, such as those proposed by Head (1999) and Raskin (2000), to reduce incidents of information overload. Incorporating easy-to-use search engines that have different levels of search sophistication and following solid design standards can contribute greatly to reducing users' frustrations with pages that appear "too busy" and list too much text.
6. Indicate when the CI displayed on a page was last updated.
7. Indicate the CI source and that person's credentials.
8. Ensure that pages contain the information indicated as therein on higher level screens, i.e., ensure that pages actually contain the contents as described on introductory screens.
9. Remove dead links regularly by implementing periodic checking and updating practices.
10. Use appropriate language when providing CI that is understandable to users.
11. Provide help mechanisms that explain the very basics, i.e., how the digital CI system and Internet are organized and function, how search engines work, etc., and explain that sometimes information is unavailable at no fault of the user.
12. Provide users with contact information (email and phone number) for someone who can assist with matching their information needs to the system and with general system use.
13. Incorporate mid-way features that allow the systems to be used by people with slower machines, etc.
14. Incorporate more ways of linking people together to facilitate social interaction via bulletin boards, etc.

By carefully considering the information needs and seeking behavior of users when designing digital information systems, many of the barriers noted earlier can be avoided or greatly reduced. Systems that anticipate related information needs and the actual activities or functions that users are trying to accomplish can go even further in facilitating users' online information behavior.

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